1253300

PATENT SPECIFICATION (11) 1253300

NO DRAWINGS

(21) Application No. 2683/69 (22) Filed 16 Jan. 1969
(31) Convention Application No. 2279 (32) Filed 16 Jan. 1968 in
(33) Japan (JA)
(45) Complete Specification published 10 Nov. 1971
(51) International Classification A 23 l 1/26
(52) Index at acceptance A2B 21

(54) IMPROVEMENTS IN AND RELATING TO THE PREPARATION OF FOODSTUFFS

(71) I, KEN HAYASHIBARA, a Japanese Subject of, 327, Higashifurumatsu, Okayama-shi, Okayama, Japan, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method for preparing foods and drinks, usually known as "foodstuffs", of intensified sweetness with no increase in the calorific value thereof.

For added sweetness of foods and drinks, it has been customary to use sugars and sugar alcohols, such as cane sugar, grape sugar, fruit sugar, starch syrup, honey and sorbitol, and artificial sweetening agents such as saccharin. These sugars and sugar alcohols are invariably crystallizable and easily form crystals in the food products under the influence of increased temperature or at high concentrations. The artificial sweetening materials have rather poor solubility and provide too high a degree of sweetness to attain the purpose of increasing the solid volume of foods and drinks as by the natural sweetenings. These properties of the common sweetening materials are inconvenient in use and limit their applications. A further disadvantage is that the sugar alcohols are absorbed and digested by the human body and, thus cannot be used in the preparation of foods and drinks of low- or non-caloric value, or dietectic or fat-reducing diets required by diabetics or obese persons.

The present invention is directed to the elimination of the foregoing disadvantages, and has for an object to provide foods and drinks having necessary sweetness by adding lactitol to food materials thereby providing sweetness like that of grape sugar and which is compatible with other artificial sweetenings such as saccharin and hence can provide freely adjustable sweetness.

Another object of the invention is to provide foods and drinks such as sponge cakes, sweet jelly of beans and concentrated juices having high degrees of sweetness which are protected against crystallization of, or whitening by, the sweetening source by adding lactitol as a sweetening source which has no possibility of crystallization even if used at high concentrations.

Still another object of the invention is to provide foods and drinks of low or no energy value per unit of weight suitable as dietectic or fat-reducing diets for diabetics and obese persons by adding lactitol in the preparation of the food products as a sweetening source which is not digested or absorbed by the human body.

Yet another object of the invention is to provide foods and drinks which stimulate the appetite by adding to the food materials lactitol as a sweetening source which enables the food products to retain or absorb moisture to an adequate level and have increased viscosity to possess the same substance, body and lustre as those of sugaryfoods, and which permits the flavourings and colourants used to be maintained in stabilized state.

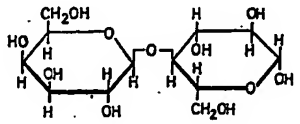
A further object of the present invention is to provide foods and drinks containing lactitol as a heat stable sweetening source which can be used as a sweetening agent for food products prepared by the application of heat, such as baked cakes, without any possibility of decomposition and colouration of the sweetening source by heat.

Thus, the present invention provides a method for sweetening foodstuffs comprising incorporating lactitol into the food materials so that the products obtained have an increased sweetness without an increase in the calorific value of the food materials.

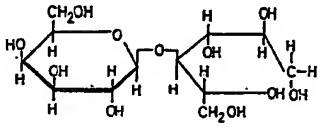
Lactitol which is used in the present invention is a reduction product of lactose that has heretofore found no application at all in the food industry. Lactose, from which lactitol is made, is a slightly sweet sugar obtained from milk. It has relatively limited applications, e.g. in the preparation of recombined milk and medicines, and is available at low cost.

Lactose is a well-known name of a com-

pound, 4 - O - [β - D - galactopyranosyl] - D - glucopyranose, as represented by the following formula:



Therefore, lactitol obtained by having one mole equivalent of hydrogen absorbed by the lactose is a polyhydric alcohol of the following structural formula:



An exemplary procedure for the production of lactitol is as follows. To pure lactose in the form of a 30% aqueous solution is added 8% Raney nickel as a reduction catalyst. The mixture is gradually heated to 100°—130°C. with constant stirring. By introducing hydrogen at a pressure of 50—100 kg/cm^2 the mixture is caused to absorb the hydrogen at a rate of one mole per mole of lactose. After cooling, the reaction mixture is freed of the Raney nickel and is purified in the usual manner by the use of active carbon and ion exchange resin. The product upon concentration yields a lactitol solution in a colourless, transparent and viscous state.

Lactitol obtained in this way showed upon an analysis no trace of direct reducing sugar, thus indicating that it had become a polyhydric alcohol. The hydrolyzed lactitol solution contains 50% reducing sugars relative to the total sugar content. This means that galactose (reducing sugar) equivalent to 1/2 molecule had been formed by the hydrolysis, and the result demonstrated that the product was pure lactitol.

Investigations on the adaptability of this lactitol for use as an additive to foods and drinks have led to the following findings;

(1) Sweetness:

A panel test on sweet taste showed that the sweetness of this substance is mild and refreshing and leaves no thick taste behind.

As for the intensity of sweetness, lactitol is milder than sucrose and is comparable to dextrose. It is by far sweeter than lactose, the starting material. It is well harmonized with saccharin, and other artificial sweetening agents, and its sweetness can be freely adjusted thereby.

(2) Non-crystallinity

Even at fairly high concentrations, lactitol cannot be easily crystallizes. When mixed with sucrose and dextrose, it also serves to avoid the crystallization of those sugars.

(3) Non-caloric value:

Lactitol has no caloric value because it is not digested or absorbed by digestive organs of the higher animal.

This was demonstrated by experiments with live rabbits. The intestines of test rabbits not fed for 24 hours beforehand were closed at both ends and were injected with a 20% aqueous solution of lactitol or an equimolecular amount of a sucrose solution each. After the lapse of several hours, the sugar or sugar alcohol left in the intestines was estimated. It was then found that, while 85 per cent of the sucrose intake had been lost due to absorption and digestion, lactitol had shown no loss, thus proving its impossibility of being absorbed and digested by the digestive organs. It was also found that lactitol has no harmful stimulus because the intestinal walls exposed to it showed no irregularity such as congestion.

Recent reports have disclosed that xylose and sorbitol, both known as non-caloric sweetening materials, are actually metabolized and cannot be as non-calorific as lactitol.

Thus, lactitol has no energy value as food and, in addition, can improve the palatability of foods with sweetness and body. For these reasons it is essential for the preparation of non-caloric drinks and edibles.

(4) Moisture retention and viscosity:

The remarkable moisture-retaining property and viscosity of lactitol are naturally expected from its chemical structure.

Lactose has a molecular weight of 360 which is comparable to that of sugar e.g. sucrose and maltose and by the breakage of the pyranose ring of glucose by reduction, forms lactitol which has a branched, complicate steric structure. Moreover, because it has nine hydroxyl groups, lactitol displays a remarkable influence of hydrogen bonds and has great moisture-retaining and moisture-absorbing properties. It thus serves as a stabilizer generally for flavourings and colourants that have polarity. Further, the intermolecular action of lactitol combines with the steric structure of the compound to give viscosity and lustre to foods.

(5) Thermal stability:

In lactitol the reducing group of lactose is stabilized by hydrogenation, and therefore it is obvious that lactitol is more stable against heat than lactose. Ordinarily lactose is very stable thermally as compared with glucose, sucrose, fructose, xylose, etc., and is decomposed at melt temperatures ranging

from 200° to 260°C. Lactitol is even more stable. It is dehydrated while being vapourized at 250°C. By virtue of this extreme stability against heat, it can be used as an additive to many different foods and drinks with no danger of decomposition or colouration upon various heat treatments.

As described hereinabove, lactitol has not only beneficial properties as an additive to food products but has such additional features as sweetness and non-caloric value. It therefore can satisfy the requirements for the preparation of non-calory foods and drinks. The present invention is illustrated without limitation by the following examples:—

EXAMPLE 1

Preparation of carbonated drink

Of carbonated soft drinks, a lemon drink is prepared having the following characteristics. The drink prepared has a saccharinity of 10.9, CO_2 gas volume of 3.5, and acidity adjusted with citric acid or the like to 0.145. In addition to suitable amounts of colorant and flavouring, lactitol is used as a sweetening material to the mixture in order to give body. Lactitol blends well with acid to provide a pleasant aftertaste and ensure thorough distribution of the flavour. Further, this sweetening agent which has no food value itself makes it possible to produce an ideal non-calorific drink for dietectic purpose. Other refreshing drinks such as Colas ("Cola" is a trade name) can be made in the same way.

Since lactitol is compatible with other sweetening, artificial or natural, the intensity of its sweetness may be adjusted with the use of another artificial agent, for example, to attain best palatability.

EXAMPLE 2

Preparation of concentrated syrup

A recipe for preparing 100 l of a concentrated syrup containing orange juice is as below:

Concentrated (1/3) orange juice	7.500 l
75% lactitol solution	75.960 l
50% citric acid solution	1.976 l
Orange base	0.500 l
Orange essence	0.250 l
Water	13.814 l

Lactitol blends particularly well with orange juice, and, unlike sugar, it will not crystallize at high concentrations and therefore can increase the overall concentration of the syrup with a sharp reduction of the proportion of water.

If necessary, the sweetness can be suitably increased by the addition of saccarin for example.

EXAMPLE 3

Preparation of ice candy

As a typical ice candy, ice cream is prepared by the following recipe:

Milk fat	10%
Skim milk powder	11%
Lactitol	20%
Stabilizer	0.2%
Artificial sweetening	Suitable amount
Flavouring	Suitable amount
Water	58.5 %

When a mixture of the above formulation is processed in the usual manner into ice cream, the product has a smooth texture and good body. With very good over run, the cream has quite refreshing, balanced flavour. Still it is a low calory food.

EXAMPLE 4

Preparation of "Youkan" (sweet jelly of beans)

Mashed beans and lactitol in substantially equal amounts are mixed up and a suitable amount of agar is added. The whole mixture is kneaded up with heat in the usual manner to a water content of about 26%. The paste thus obtained is shaped as by moulding and packed.

By virtue of the high thermal resistance, lactitol will not be baked in the course of the kneading with heat, but will keep the mixture in the tint desired. It does not crystallize and provides a jelly with such fine lustre and taste that stimulate the appetite. If necessary, the sweetness can be adjusted with the use of saccharin for example.

"Youkan" made in this way is a low-calory food because its caloric value is about one-third the values of conventional products.

EXAMPLE 5

Preparation of sponge cake

A typical formulation for the preparation of a sponge cake is as given below.

Lactitol (anhydrous)	940 g.
Egg	1,100 g.
Flour	900 g.
BP	10 g.
Monoglyceride	Suitable amount
Vanilla	6 g.
Water	200 cc.

These ingredients are mixed in the usual manner to form a dough. The dough is spread over a sheet of paper laid on an iron plate, and is baked in an oven. After cooling, it is suitably decorated on the surface according to the amount charged, and thus a sponge cake is obtained.

No scorching will occur during the course of baking, and the product is rendered soft and allowed to maintain suitable moisture.

Thus, a flavoury cake resistant to ageing is made.

With a carbohydrate content about half those of ordinary products, the cake is a low-calory food.

EXAMPLE 6

Preparation of canned food

In the case of canned orange, the fruit is packed in cans in the usual manner and the cans are fillted with a syrupy solution according to the invention. To 50 kg. of lactitol (in anhydrous state) are added 35 g. of saccharin. With the addition of water, a total of 100 kg. of a syrupy solution is obtained. This solution has suitable viscosity and is harmonious with sourness. It retains the flavour of the fruit and is non-calorie *per se*.

EXAMPLE 7

Preparation of bottled marrons in syrup

Chestnuts with the astringent skin peeled off are allowed to stand overnight in water. Then, with the addition of 0.1 to 0.3% alum, the nuts in water are boiled to stiffen the flesh and to keep their shape. After the removal of water, the nuts are immersed in a 50% lactitol solution, heated at 80°C. for 10 minutes, and then are left as they are. On the following day, 0.07% of saccharin, both on the basis of the amount of a 70% aqueous solution of lactitol, are added to the latter solution. The mixture is diluted to a solution in which the lactitol content is between 50 and 65%. Together with 110 g. of the syrup thus obtained, the marrons prepared as above are bottled.

In the manner described the marrons are completely kept from colouration due to reducing sugar and have fine yellowish colour. With suitably stiffened flesh and beautiful lustre the marrons have pleasant sweetness. Thus, lactitol permits the preparation of marrons soaked in syrup which has heretofore been impossible without the aid of sugar. Further, because the syrup has no food value, the product can serve as a low-calory food with a calorific value reduced to one half or less those of ordinary ones.

EXAMPLE 8

Preparation of artificial "sake"

An exemplary recipe is given below:

Alcohol (90%)	810 l
Lactitol	150 kg.
Saccharin	0.1 kg.
Sodium glutamate	600 g.
Succinic acid	3,900 g.
Lactic acid (75%)	770 g.
Potassium hydrogen phosphate	330 g.
Calcium hydrogen phosphate	330 g.
Sodium succinate	650 g.
Sodium chloride	600 g.
Arachone-glycine	350 g.
Fermented liquor for seasoning	450 l.

With the addition of water to the composition to an overall volume of 5400 l, the whole solution is kept still in cool place and, after screening, it is aged for one month. The "sake" thus prepared is pasteurized at 50°C. and bottled.

This synthesized "sake" has the extract content and consistency demanded of natural fermented "sake", and has good body. Free from sugar and with nearly no calorific value, the product may well be called a non-calory artificial "sake". It features stable body and flavour and well balanced taste.

EXAMPLE 9

Preparation of white wine

After removal of their skins and stones, grapes are squeezed to yield juice. Potassium pyrosulfite is added to the juice to inhibit the growth of infectious microbes and seed mash is added for fermentation purpose. Upon completion of the fermentation, suitable proportion of lactitol and alcohol are incorporated. The whole solution is then casked and fermented. Subsequently it is stored and bottled in the usual manner.

The following is a typical recipe for the preparation of white wine.

Grape juice	170 l.
Potassium pyrosulfite	40 g.
Seed mash	7 l.
Alcohol (80%)	10 l.
Lactitol	5 kg.
Saccharin	4 g.

White wine thus produced has practically same alcohol content, extract content and acidity as those of conventional white wines but contains little sugar. The mild sweetness of lactitol and the flavour of wine are well balanced by ageing and the product can remain palatable for long. The product has the suitable sweetness of ordinary white wine, and is finely coloured like best of white wines, and yet has almost no energy value. With these features, the wine is a most suitable low-calory dietetic drink for diabetes and obesity.

EXAMPLE 10

Preparation of sweetened condensed milk

Raw milk whose fat content has been adjusted beforehand is subjected to flash pasteurization at 110° to 130°C. The milk is then boiled for a short time and, after the addition of lactitol in an amount equivalent to 15% of the amount of raw milk, the milk is condensed. By means of a cooler, the milk is cooled to a temperature below 15°C. and is treated so as to pulverize the lactose to finer crystals.

An exemplary composition of the milk is as follows:

Water content	26%
Solid matters of whole milk	29%
Fat	8%
Protein	7
Lactose	12
Ash content	1.5
Lactitol	45
Saccharin	0.01

This condensed milk has fine creamy lustre and suitable viscosity. Since the fat content is thoroughly dispersed and the crystallization of lactose is avoided, the milk is pleasant to the palate. It is a low-calory food with an extremely low calorific value, less than one sixth the values of conventional condensed milks.

EXAMPLE 11

Preparation of drops

Into 14 kg. of a 70% solution of lactitol are added 45 g. of saccharin, with suitable amounts of acid and flavouring. The mixture is condensed in vacuum to a water content of 1% or less. The resultant upon cooling and shaping gives drops.

The product has refreshing sweetness and stable flavour and colour. It remains palatable for long, and can be taken as non-calory drops.

WHAT I CLAIM IS:—

1. A method of sweetening foodstuffs comprising incorporating lactitol into the food materials so that the products obtained have an increased sweetness without an increase in the calorific value of the food materials.

2. A method of sweetening foodstuffs substantially as hereindescribed.

3. Foodstuffs prepared according to Claim 1 substantially as hereindescribed with reference to Examples 1 to 11.

PAGE, WHITE & FARRER
Chartered Patent Agents,
27, Chancery Lane,
London, W.C.2.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1971.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.